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# A comparison of cooperative learning and conventional teaching on students' achievement in secondary mathematics

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## Abstract

Cooperative learning (CL) has been a preferable alternative to conventional teaching (CT) for recent decades. This study aimed at comparing the effects of CL and CT on mathematics achievement in Sreepur Adarsha Girls' High School. Sixty two students of grade-IX participated in this study where quasi-experimental design was employed. Both the experimental group (EG) and control group (CG) were guided by the same teacher in one academic session for fifteen weeks. The results showed a statistically significant difference in favour of the EG after CL treatment. The findings revealed that the cooperative students significantly outperformed the conventional students. As such, CL can effectively be implemented to improve students' achievement in secondary mathematics.

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*Keywords:* Cooperative learning, conventional teaching, quasi-experimental design, Natore Bangladesh;

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## 1. Introduction

This study investigated the teaching and learning of mathematics based on CL principles in Sreepur Adarsha Girls' High School in Natore, Bangladesh. The present education system of Bangladesh is divided into five major stages: primary, junior secondary, secondary, higher secondary and tertiary education. Bangla is the mother language and the national language as well. The medium of instruction is Bangla while it is taught as a compulsory subject in general and mathematics is taught as a compulsory subject across primary, junior secondary and secondary levels in particular (Government of Bangladesh 1997). At the secondary level i.e., grade IX and X, mathematics is taught as a compulsory subject (which the study is focusing on) while science education is optional. The duration of secondary education is two years with grades IX-X. A public examination secondary school certificate (SSC) is conducted at the end of two years study. The SSC examinations are significant for pupils and guardians all over the country. This is the first major public or school leaving examinations faced by the youngsters under seven educational boards across the country. The SSC result is an indicator of quality of secondary education but high rates of failures in SSC examinations reflect poor quality of secondary education. Relatively higher failure rates in mathematics indicate deficiency in teaching of this subject at rural secondary schools. Although eminent educationists and education administrators of the country have taken various serious efforts to improve secondary

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education for the past few years but it is regretful that the percentage of pass as seen in the year 2005 SSC examination result was below twenty percent at a large number of schools in the rural areas (Board of Intermediate and Secondary Education 2005). According to Ali (1987), teachers in the mathematics classrooms follow the teacher-centred teaching method in secondary school context. This CT method affected SSC examination in rural areas because of teachers' mathematics teaching strategies is essentially based on utilizing their individual creativity; teachers are familiar with traditional method of teaching where teachers are the active participants in the classrooms while the students are passive recipients of knowledge. Therefore, it is necessary to evaluate the method that satisfies both the students and teachers in mathematics learning.

After having researched for a long time in the field of CL, Webb (1984) commented that CL had significantly improved learners' performance in mathematics. Further, similar view had been seen on CL in Davidson (1990), Kolawole (2007), Kagan (1994), and Ozsoy and Yildiz's (2004) studies. Azizah and Chong (1999) and Effandi (2003) mentioned, from the findings of their studies which have been carried in Malaysia, that CL group, in general, achieved higher mathematics score than CT group. As such, the researcher emphasized on CL approach in the selected secondary mathematics classrooms.

According to Johnson and Johnson (1994), CL is the instructional use of small groups through which students work together to maximise their own and each other's learning. CL is working together to accomplish shared goals. CL is also an instructional approach in which high-ability and low-ability students work together to solve a problem. There are many strategies in CL such as Student Teams-Achievement Division (STAD), Teams-Games-Tournaments (TGT), Cooperative Integrated Reading and Composition (CIRC), Team Accelerated Instruction (TAI), Jigsaw, Group Investigation (GI) etc, but the researcher was interested in Learning Together model in carrying out this study. The Learning Together model is a CL strategy developed by Johnson and Johnson (1994) to improve students' achievement. Johnson and Johnson carried out a number of studies on cooperative learning and found in general significantly greater achievement in CL in comparison to individualistic and competitive teaching instruction for all types of students. They also found that CL helped to improve relationship between high-ability and low-ability students, increasing self-esteem and development of positive attitudes toward mathematics. Moreover, Johnson and Johnson (2004) in their study state that since 1897, over 550 experimental studies have been conducted on CL in different disciplines, and the results show the effect of CL promote more positive attitudes toward the task as well as cooperation tends to promote higher achievement. Thus, the major purpose of this research study was to investigate the effects of CL on mathematics achievement in the selected secondary mathematics classrooms. The specific objective of the study was:

1. To examine the effects of CL on students' mathematics achievement in secondary mathematics classrooms of Sreepur Adarsha Girls' High School in Natore, Bangladesh.

## 2. Hypotheses

Based on the above objective the following null hypotheses were tested at 0.05  $\alpha$ -level:

Ho1: There is statistically no significant difference in mathematics achievement pre-test mean scores between students in EG and CG.

Ho2: There is statistically no significant difference in mathematics achievement post-test mean scores between students in EG and CG.

## 3. Literature

Cooperative learning has been a subject of interest to researchers for the past three decades. At the secondary school levels, there is a substantial body of literature supporting the idea that students can attain higher achievement, especially in mathematics, through working together in groups. CL is achieved by dividing the class into small groups that work together to achieve the best group results by means of mutual assistance among the group

members. All the members of the group must work on the task assigned by the teacher and each is aware that the success or failure of each individual will affect the result of the whole group (“your success benefits me and my success benefits you, in short we all sink or swim together here”) (Johnson & Johnson 1994).

To find out the effects of Cooperative Learning (CL) on secondary students’ mathematics achievement, the researcher in this study focused on Johnson and Johnson’s (1994) Learning Together model of CL because their approach of developing group learning based on five basic principles is widely applicable in any CL situation. Vaughan (2002) supported Johnson and Johnson’s model that Learning Together, a cooperative learning strategy, is crucial to the cultivation of individual and academic success. Johnson et al. (1998) reviewed one hundred and sixty eight studies comparing CL to traditional styles of instruction focusing on student achievement to strengthen the case for using CL in mathematics. They found that the use of CL facilitated learning in an active rather than a passive way. They claim that CL must be employed in mathematics classes if mathematics instruction is to help students think mathematically, understand the relationships among various mathematical facts and formulas, and apply mathematical knowledge. Rimmerman (2004) referred to Johnson and Johnson’s work as the modern era of cooperative learning. Their model of CL is known as Learning Together and can be applied to any discipline and grade level.

The elements in Learning Together model of CL are based on some general theoretical perspectives. Johnson and Johnson (1994) believed that CL comes from three different theoretical perspectives: social interdependence, cognitive development, and behavioral learning. They discuss three theoretical perspectives underlying CL.

One of the underlying theories is the social interdependence perspective, which began in the early 1900’s. Deutsch (1949), an advocate of the social interdependence theory, believes that the individuals interact with each other and this is determined by how social interdependence is structured. There are two ways in which individuals interact. One way is done through “promotive” interaction, which originates from positive interdependence among group members and the other, oppositional interaction, which results from negative interdependence where each member tries to minimize or prevent other members’ success.

The second theoretical perspective underlying CL is the cognitive development perspectives, which is advocated by Piaget (1965). The cognitive development theory proposes that when group members are involved in CL activities, they will participate in discussion where cognitive conflicts may appear and these will then be resolved. Participants will present their information and views, discuss each other’s information and insights, identify weakness in each other’s reasoning strategies, make corrections and learn new information and concepts from each other.

The final perspective is the behavioral social perspectives, which is purported by Bandura (1977). The behavioral learning theory emphasizes the effects of group reinforcement and the extrinsic motivation for learning. The principle supports Slavin’s (1983) theory that extrinsic group rewards would promote further interaction and increase efforts to learn among CL group members.

Johnson and Johnson (1994) advocated a five-component theory, which includes five essential elements for maximizing the success of the CL approach. These elements include positive interdependence, individual accountability, face to face “promotive” interaction, social skills and group processing. They argued that the five elements are essential for the successful implementation of CL in the mathematics classrooms. The five elements of CL are briefly described below.

The first major element of CL is positive interdependence. Positive interdependence is the heart of CL. Students must believe that they sink or swim together. They must only learn the materials by themselves, but the students should also help or make sure that their team members learn the materials. Members perceive that they are linked in such a way that one cannot succeed unless every one succeeds (Johnson & Johnson 1994).

The second essential element of CL is individual accountability. Each member is responsible for their own learning as well as that of their group members. Individual accountability exists when the performance of each individual student is assessed by other group members and the results are given back to the group and the individual. The group is accountable for achieving its goals and each member is responsible toward contributing his or her share of work (Johnson & Johnson 1994).

The third element of CL is face-to-face “promotive” interaction, which occurs when individuals encourage and facilitate each group member’s effort to achieve the group goals. It is the opportunity for students to promote each other’s success by supporting and encouraging each other. The support and encouragement are established through verbal and nonverbal responses of the group members. Students do real work together in which they promote each

other's success by sharing resources, helping, supporting, encouraging and praising each other's efforts to learn (Johnson & Johnson 1994).

The fourth element involves the appropriate use of small-group and interpersonal skill. Whenever one works with others, social skill is needed. Students must be taught the social skills for high-quality cooperation and be motivated to use them. Students must know how to communicate and manage conflicts. The last key essential is group processing. Group processing is an evaluation step for groups to discuss their performance, how well students are achieving their goals and maintaining effective working relationships. Students should have time to think about how well they are achieving the common goal. Groups need to be able to describe which actions are helpful and which are harmful. This allows the group to reflect on how effective their team is in achieving its goals (Johnson & Johnson 1994). As such CL, the integration of the three theories and their elements, was implemented as a useful tool to develop students' mathematics achievement in Sreepur Adarsha Girls' High School in Natore, Bangladesh.

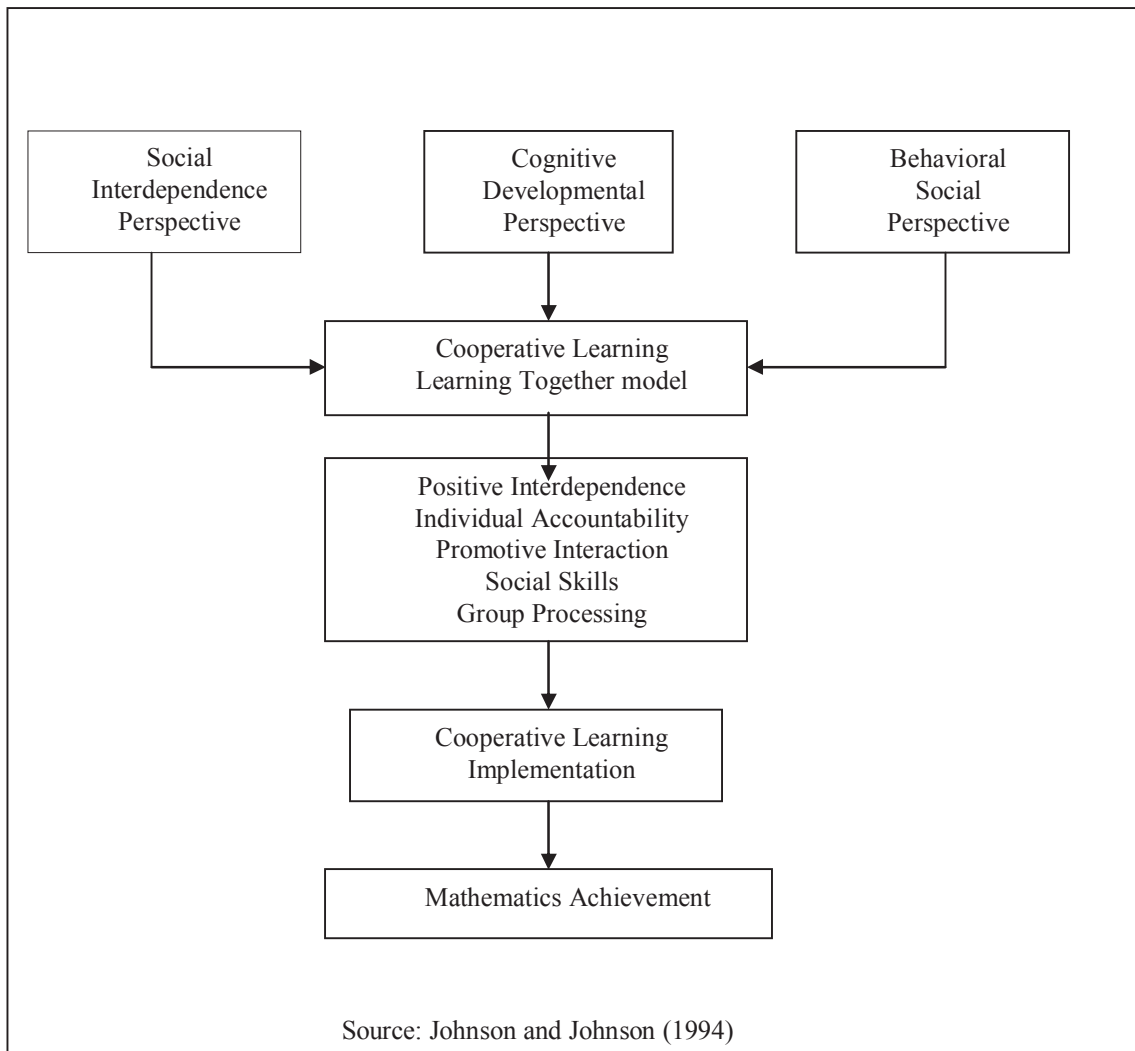


Figure 1. Shows the theoretical framework of the present study

Johnson and Johnson (1990) state that people do not know how to interact effectively with others. Nor do interpersonal and group skills magically appear when needed. Students must be taught group skills and motivated to use them. Thus, in order to achieve mutual goals students should be instructed how to communicate accurately and resolve conflicts constructively. Small groups in CL in mathematics teaching-learning strategies are more effective to promote students' achievement than traditional method of teaching. Previous studies showed that small groups in CL produced positive influence in mathematics achievement and improved students' attitudes toward mathematics. Johnson and Johnson (1994) supported that small groups in CL promoted students' mathematics achievement in grade nine and ten. Other studies also had similar findings in different mathematics grades reported by Kagan (1994), Webb (1984), Davidson (1990) and Slavin (1983). These results indicated that those students who worked with CL had higher mathematics performance than the CG in the same setting. These findings emphasized the academic advantages by using CL approach in mathematics instructions for students' learning. Therefore, small groups in CL are positive to improve students' mathematics achievement.

Johnson and Johnson (1994) pointed out students' helping behaviours are strongly related to their academic achievement. CL establishes a community in which students can get help and support from other group members immediately in a non-competitive learning environment, just raising their hands and waiting for the right answers to be given. Hiltz (1994) and Panitz (1999) found that the complex concepts or difficult problems are to become easier when they learn mathematics by using CL. One of the reasons to promote performance may be that students get help through discussion to create peer support and expand deeply thinking and perspectives with their group members. Sharan and Sharan (1992) also stated that students in cooperative small group of mathematics instruction would have a strong emphasis on exploration and active participation, which did not often appear in traditional mathematics classrooms. These activities are to benefit the students' achievement because these provide more equal opportunities in sharing knowledge.

Reid (1992) studied the effect of CL strategies on mathematics achievement of 7th graders. Reid collected information based on school records indicating whether a student had participated in the CL strategies or had received individualized or competitive instruction. He found that, the means of CL groups were significantly higher than that of the other groups, and concluded that CL strategies were more effective in promoting mathematics achievement, confirming the results of similar studies. Also, Rao (1986) made a comparative study to find out the efficiency of two programs of learning method over the CT method in the instruction of mathematics in school education. He found that the mean performances scores of the entire program learning group were higher than those of the corresponding CT method. In a matriculation level mathematics class, Effandi (2003) also found that there was an overall significant difference between the CL and traditional groups in terms of mathematics achievement and problem solving skills. This study of intact groups compares students' mathematics achievement and problem solving skills. The EG was instructed using CL methods and the CG was instructed using the traditional lecture method. CL group instruction showed significantly better results in mathematics achievement and problem solving skills. He concluded that the utilization of CL methods is a preferable alternative to traditional instructional method.

Ozsoy and Yildiz (2004) conducted an experimental research on the use of CL in mathematics. The purpose of their study was to investigate the effect of Learning Together, a cooperative learning strategy, had on mathematics achievement. The study took place in Blikesir, Turkey. In the study, the control group received traditional mathematics instruction, while the experimental group received mathematics instruction using Learning Together method of CL. The researcher used the pre-test and post-test design and compares mean scores. Results revealed a significant difference in favour of the Learning Together cooperative learning techniques. Also, in a quasi-experimental study, Kolawole (2007) investigated the effects of CL and competitive learning on mathematics achievement. The rationale behind the study was to determine which one of the learning strategies is more effective. The sample consisted of senior secondary students from South West Nigeria. Data were collected from mathematics pre-test and post-test. Using a z-test to analyse the data collected, Kolawole found that CL strategy was significantly more effective than competitive learning. Additional findings indicated that male in the study significantly performed better than female in both learning strategies.

Mwerinde and Ebert (1995) conducted the study in which the CG did significantly better than the treatment group. Baseline assessments had the EG more mathematically experienced but the CG achieved higher grades. The composition of the cooperative groups in the EG was not properly structured might be the cause of showing higher grades to the students of the CG. On the contrary, the study carried out by Lee (1999), using TGT and STAD as a model found that students who were taught with a cooperative structure outperformed the students in individualistic



goal structure in mathematics problem solving. Other researchers have reported similar findings that point to the achievement benefits of using CL (Faizah 1999).

Whicker et al. 1997 investigated the effects of CL on students' achievement and attitudes in a secondary mathematics classroom. They found that students in the CL group had increasingly higher test scores than students in the comparison group. In the same way, Vaughan (2002) examined the effects of CL on the achievement and attitudes toward mathematics of a group of fifth grade students. Students participated for twelve weeks in CL in mathematics. The analysis of pre-test and post-test scores revealed positive gains in attitudes and achievement. Suhaida (2000) investigated the effects of using CL (specially, STAD) in secondary classes. The study involved 208 subjects from secondary schools and was conducted over 8 weeks. In terms of achievement, the results showed that the CL group outperformed the traditional group. In another study, Yee (1995) found that Jigsaw and Circle of Learning methods increased the achievement of form four secondary school students learning mathematics. Jacobs et al. (1996) conducted a study to investigate how well the positive effects of CL would generalize to private elementary schools, comparing mathematics achievement, friendship, attitudes toward mathematics and self-concept outcomes of student taught with and without CL. Significant increase in mathematics achievement surfaced for CL groups but only differential effects for CL with the three affective student outcomes. Likewise, Owens et al. (1998) and Rieck et al. (1995) conducted the study in which the EG did significantly better in achievement and increased in attitudes towards mathematics than the CG. They found that students in the EG expressed enjoyment working in groups.

Based on the report of Chong (2003), CL has been carried out in Malaysia in various disciplines like science, mathematics, English as a second language, Bahasa Melayu, Islamic studies and special education found CL, in general, shows better achievement than the CT method (Azizah & Chong 1999). Based on the literature, to ensure students' success, teachers may employ the CL principles where students are the centre of focus, the student should be actively engaged in the learning process by understanding, sharing, helping one another to achieve shared group goals. Thus, the main thrust of this research was to develop, enhance and strengthen CL practices in the secondary school mathematics classrooms in Sreepur Adarsha Girls' High School of Natore, Bangladesh.

#### 4. Methodology

To find out the effects of CL in comparison to CT, the study employed a quasi-experimental "Equivalent control group with pre-post test" (Campbell & Stanley 1963; Berg & Latin 1994) design. Figure 2 shows a graphic form of quasi-experimental design of this study. In Figure 2, A represents the EG while B represents the CG.  $O_1$  represents the pre-test while the post test is represented as  $O_2$  for the EG and CG respectively. The CL treatment is represented as X.

Table 1. Equivalent pre-post test control group design

Groups	Pre-Test	x	Post-Test
Experimental Group (n=31)	$O_1$	X	$O_2$
Control Group (n = 31)	$O_1$	X	$O_2$

##### 4.1 Sample

The sample under this study is the grade IX students of Sreepur Adarsha Girls' High School in Natore, Bangladesh. Prior to the implementation of the study the researcher obtained permission from the District Education Officer of the Government of the People's Republic of Bangladesh for conducting the study. A total of 62 full-time students (31 students for EG and the other 31 students for CG) from Sreepur Adarsha Girls' High School constitute the sample. The experimental school comprised two sections in which Section-I was represented as the EG while

Section-II represented the CG in Grade-IX mathematics classrooms as per the directives of the Headmasters of the sample school.

#### 4.1.1 Implementation of Cooperative Learning

The mathematics teacher who was assigned to implement CL in this study was properly trained before embarking on the task. At the beginning of the experiment, pre-test of the students' mathematics achievement was administered and the students were informed that they would be exposed to CL from the 2<sup>nd</sup> of February to 15<sup>th</sup> of May in 2008 that would help them become more effective members of their own learning activities. The teachers introduced the process of Learning Together model of CL to the students in the EG. They discussed with them about the importance of using this model in the mathematics classrooms. The teachers spent some time to introduce the concepts with regard to how students can become cooperative students within the CL environment, why they would learn Learning Together model of CL, and how they could apply this model to improve their achievement in mathematics. After the discussion on CL, students were assigned into groups based on their ability. After implementing CL, students were asked to complete the post-test of the students' mathematics achievement in the last mathematics session of the experiment.

## 5. Results

Independent-sample t-test was used to test the hypotheses. The students' mathematics achievement pre-test and posttest scores were recorded for each of the sixty two students. According to Morgan et al. (2001), the two groups are normal if their skewness be positioned between negative one and positive one. Since the skewness was between -1 and +1, the distribution was considered normal. A second check for normality using the SPSS recommendation that the skewness divided by the standard error of skewness should be between negative two and positive two (SPSS 1999) confirmed that the two groups were normal. The skewness divided by its standard error was -2 and +2, confirming normality. Moreover, the Levene's test for homogeneity of variances was conducted to test the homogeneity of variances. The results showed that the basic assumption has not been violated. The results derived from pre-test and post-test are discussed below:

Independent-sample t-test was applied to test the hypothesis Ho1 that there is statistically no significant difference in mathematics achievement pre-test mean scores between students in EG and CG. A non-significant difference was found ( $p > 0.05$ ). Ho1 was not rejected with  $p > 0.05$ . The difference between these two pre-test was not significant at the 0.05  $\alpha$ -level. It means that there was no significant difference on mathematics achievement between EG and CG at the pretest stage. The results also indicated that the EG did not perform significantly better than CG on students' mathematics achievement pre-test. For the students' mathematics achievement pre-test, the analysis also showed that both the EG and CG had low performances in students' mathematics achievement prior to the exposure to the treatment strategy. At the pre-treatment stage, both the CG and EG had low overall students' mathematics achievement. Thus, it can be concluded that the performances of both EG and CG were equivalent in terms of students' mathematics achievement prior to the implementation of CL with regard to learning mathematics in secondary level.

To test the hypothesis Ho2, independent-sample t-test was applied that there is statistically no significant difference in mathematics achievement post-test mean scores between students in EG and CG. A significant difference was found ( $p < 0.05$ ). Ho2 was rejected with  $p = 0.00$ . The difference between these two post-test was significant at the 0.05  $\alpha$ -level. It means that there was a significant difference on mathematics achievement between EG and CG in posttest. The difference between these two post-test was significant at the 0.05  $\alpha$ -level in favour of the EG which revealed that the performance of EG was significantly better than CG for experimental students as compared to conventional students. The EG showed improvement in the students' mathematics achievement mean scores of the post-test. The results indicated that there was an increase in the mean scores of students' mathematics achievement post-test in the EG after the treatment. The results suggested the effect of the CL was minimal. Thus, it could be concluded that the treatment strategy of CL approach appeared to have a substantial and positive effects on the overall students' mathematics achievement post-test mean scores for the EG. As for the CG, there was minimum improvement in their overall students' mathematics achievement post-test mean scores.

### 5.1 Findings

This study attempted to investigate the effects of CL on students' mathematics achievement in the secondary school mathematics classrooms. The major findings of the study are as follows:

1. The effects of CL on mathematics achievement were significant. The results revealed that CL had significant effects on students' mathematics achievement. The results also showed that the experimental students significantly improved their mathematics achievement in comparison to conventional students. The students in the EG significantly outperformed the CG students after CL implementation.

#### 5.1.1 Discussion

In this research study, on the whole, it appears that EG of CL performed significantly better than the CG taught by CT method. The interview sessions with the teachers also supported the use of CL in the rural secondary school mathematics classrooms. As such, CL proved to be more favorable for the experimental teachers and students.

Findings from this study indicate that the treatment strategy of CL had significant effect on students' mathematics achievement. Prior to the treatment, the independent-sample t-test was administered for null hypothesis one ( $H_01$ ) to find out any significant difference in mathematics achievement pre-test mean scores between students in EG and CG. The findings revealed that both the EG and CG were equal ( $p > 0.05$ ) in their performances by showing a low overall students' mathematics achievement. After the treatment, the independent-sample t-test was done for null hypothesis two ( $H_02$ ) to find out any significant difference in mathematics achievement post-test mean scores between students in EG and CG. The findings indicate that EG students showed significant ( $p < 0.05$ ) improvement in students' mathematics achievement in comparison to CG students. The results suggest that the increase of the students' mathematics achievement post-test mean scores for the EG was due to the significant effects of CL treatment. On the other hand, the CG shows minimum changes in the students' mathematics achievement post-test mean scores. The findings of this study, therefore, are consistent with the results of similar research reviewed in literature. The findings on CL show that CL improves students' mathematics achievement, as shown by the studies of Davidson (1990), Johnson and Johnson (1994) and Kagan (1994). The findings of this study are also consistent with studies by Effandi (2003), Faizah (1999), Kolawole (2007), Lee (1999), Ozsoy and Yildiz (2004), Rao (1986), Slavin (1983), Suhaida (2000), Web (1984) and Yee (1995). The findings are in contrast to the findings by Mwerinde and Ebert (1995) and support the results reported by Reid (1992) and Whicker et al. (1997) as well as in line with the findings by Jacobs et al. (1996), Owens et al. (1998), Rieck et al. (1995) and Vaughan (2002).

Moreover, the post test result indicates that CL provided students with the opportunity to determine their algebraic expression, geometric theorem and trigonometric ratio confidently. CL enables students to acquire the appropriate procedural problem solving techniques, and therefore, they were able to solve their problem accurately than the students in the CG. Students in the EG worked cooperatively to obtain shared group goals. The cooperative group provides a more intimate setting that permits direct and unmediated communication (Sharchar & Sharan 1994). Such a context, proponents of CL belief, is a key to students engaging in real discussion and wrestling with ideas. Therefore, the CL method provided the experimental students with the opportunities to stretch and extend their thinking more than the students in the CG.

#### 5.1.1.1 Implications

In the literature, it is found that students in grade nine and ten improved their mathematics achievement by working with small groups in CL (Johnson & Johnson 1994). Other studies carried out by Davidson (1990), Effandi (2003), Faizah (1999), Kolawole (2007), Kagan (1994), Lee (1999), Ozsoy and Yildiz (2004), Slavin (1983), Suhaida (2000), Webb (1984) and Yee (1995) also had similar findings that the students under CL treatment had higher mathematical performance than CG. The findings of the present study further supported that the students in the EG significantly outperformed the CG students after CL implementation. Since the findings of this study showed a great improvement in students' mathematics achievement, therefore, to promote students' mathematics



achievement, CL can successfully be implemented in the secondary school context in Natore, Bangladesh. Education authorities in Bangladesh should encourage secondary teachers to implement CL and teacher education institutions to make it part of their curriculum content. Future studies may focus on the longitudinal study of cooperative learning on academic achievement in various disciplines.

## 6. Conclusion

The effects of CL are significant on mathematics achievement between the students' learning cooperatively and students' learning conventionally. Prior to the treatment, it was found that both the cooperative and conventional students were equivalent with low overall mathematical performances. After the treatment, experimental students showed significant improvement in students' mathematics achievement in comparison to conventional students. It indicated that the increase of the students' mathematics achievement for the EG was due to the significant effects of CL treatment. As such, this study helped to advance our understanding on the practical contribution of CL as it positively affected students' mathematics achievement. This should provide a scenario of cooperative learning practices in mathematics classrooms in the rural areas of secondary school context. Teachers may apply the most suitable approach CL in their teaching instruction in order to enhance students' better performance in mathematics. Integrating CL in secondary mathematics classroom, this study came to a conclusion that CL principles are more effective in promoting students' mathematics achievement. This may encourage future studies by looking closer at the positive effects of CL on students' mathematical performance and to develop a more adequate explanation of the effects of cooperative learning.

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